Delta Smelt Investigations

Dale Sweetnam

Both 1995 and 1996 were wet years, but delta smelt responded differently to environmental conditions. The 1995 water year (wet) was a stressor year to delta smelt because of extremely high outflow; the 1996 water year (above normal) should have been good for delta smelt because the X_2 isohaline was in Suisun Bay for most of the spring. Because we now sample for delta smelt nearly year round, we can better determine what periods are critical to their survival.

Delta smelt abundance indices from both the summer tow-net survey (Figure 1) and the fall midwater trawl survey (Figure 2) vary dramatically from year to year and do not necessarily track each other. In 1995, the summer tow-net survey was low and the fall midwater trawl index was high. In 1996, the situation was the opposite — the tow-net index was up and the fall abundance was a near-record low. The 1996 results are disturbing because spring habitat conditions in Suisun Bay (X_2 isohaline was in Suisun Bay for 80 days) predicted a relatively good fall abundance (Figure 3). In contrast, spring habitat conditions in Suisun Bay in 1995 predicted fall abundance would be low, because the X_2 isohaline was downstream of Suisun Bay in February-June. The X_2/abundance relationship has only accounted for about one-fourth of the variability in delta smelt abundance in the fall. Addition of the 1995 and 1996 results further weakens this relationship, suggesting other factors were more important in determining delta smelt population strength in these years.

Because of the low fall abundance index, average delta smelt density as measured by three sampling programs were compared for 1995 and 1996 (Figure 4). Although each sampling gear has different sampling efficiency, biases, and locations, the comparison gives insight as to when the population declined. The 1996 year class appears to have been more abundant than the 1995 year class until August, when the midwater trawl survey collected very few delta smelt. Concerns over low delta smelt catches prompted the Resident Fishes Project Work Team to discuss possible mechanisms for the decline, including changes in growth rate, food limitation, contaminants, and temperature. Another decision of the team was to move the November Kodiak trawl survey to October to verify the low delta smelt numbers. This survey collected 263 delta smelt at 12 stations in a geographical sweep of the estuary. Although this survey did catch more delta smelt than the October midwater survey in a wider distribution, density was an order of magnitude lower than in the 1995 Kodiak trawl survey. The highest density in 1996 was 139.6 delta smelt/10,000m^3; the highest in 1995 was 1156.1 delta smelt/10,000m^3. This suggests that numbers of young-of-the-year delta smelt are indeed lower than was expected based on the spring 20mm survey and summer tow-net survey.

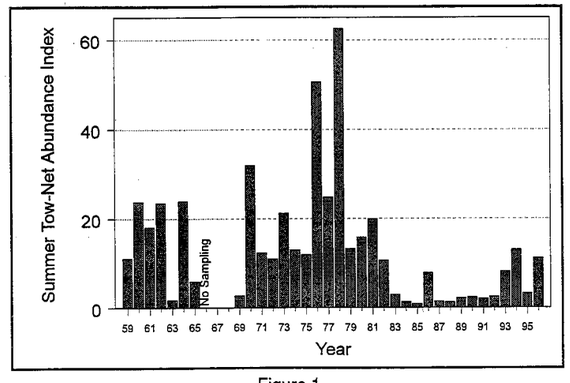

Figure 1
SUMMER TOW-NET ABUNDANCE INDEX FOR DELTA SMELT
Values represent the sum of volume-weighted means of 8 sampling areas. The average of the first two surveys is used. No sampling in 1996-1969.

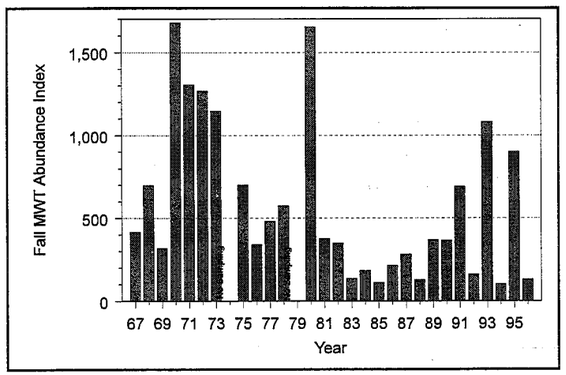

Figure 2
FALL MIDWATER TRAWL ABUNDANCE INDEX FOR DELTA SMELT
Values represent the sum of volume-weighted means of 17 areas sampled monthly, September through December. No sampling in 1974 and 1979.

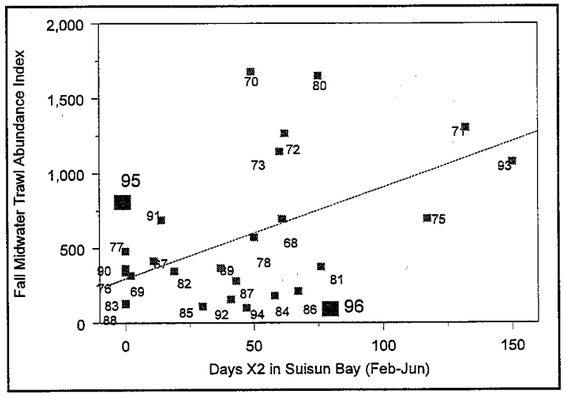

Figure 3
RELATIONSHIP BETWEEN NUMBER OF DAYS THE X_2 ISOHALINE IS IN SUISUN BAY IN FEBRUARY-JUNE AND DELTA SMELT ABUNDANCE AS MEASURED BY THE FALL MIDWATER TRAWL SURVEY
Without years 1995 and 1996: y=6.128x+296.8, r^2=0.28, n=26, p=0.006. With years 1995 and 1996: y=5.026x+345.2, r^2=0.19, n=28, p=0.02.

In spring, delta smelt were widely distributed throughout the estuary, from the lower Sacramento River and the delta to the Napa River. By summer, delta smelt distribution had narrowed to the lower Sacramento River to Suisun Bay (Figure 5). By November, distribution was limited to the lower Sacramento River (Figure 6) until the first large outflow event in December, which shifted distribution to Suisun Bay.

Salvage of delta smelt at the CVP and SWP was much higher in 1996 than in 1995. In all, 91,447 delta smelt were salvaged at both facilities in 1996 as compared to 2,578 in 1995 (Figures 7 and 8). The 1996 salvage exhibits the two characteristic peaks of delta smelt salvage: a small peak in January or February resulting from adult delta smelt moving upstream into fresh water to spawn, and a larger peak in May-July of young-of-the-year delta smelt. The 1995 salvage pattern is interesting in that no young-of-the-year delta smelt were salvaged in May-July. This was the first year of record that no delta smelt were

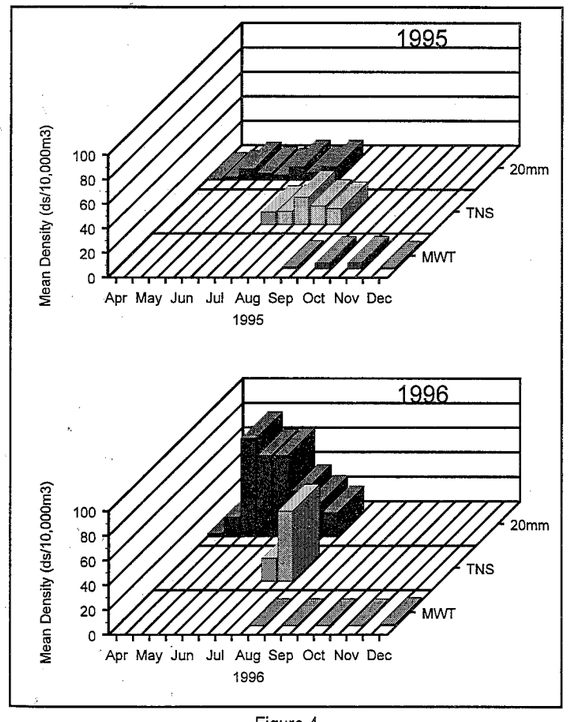

Figure 4
AVERAGE DENSITY OF DELTA SMELT COLLECTED IN THREE SAMPLING PROGRAMS
Densities are in number of delta smelt/10,000m^3.

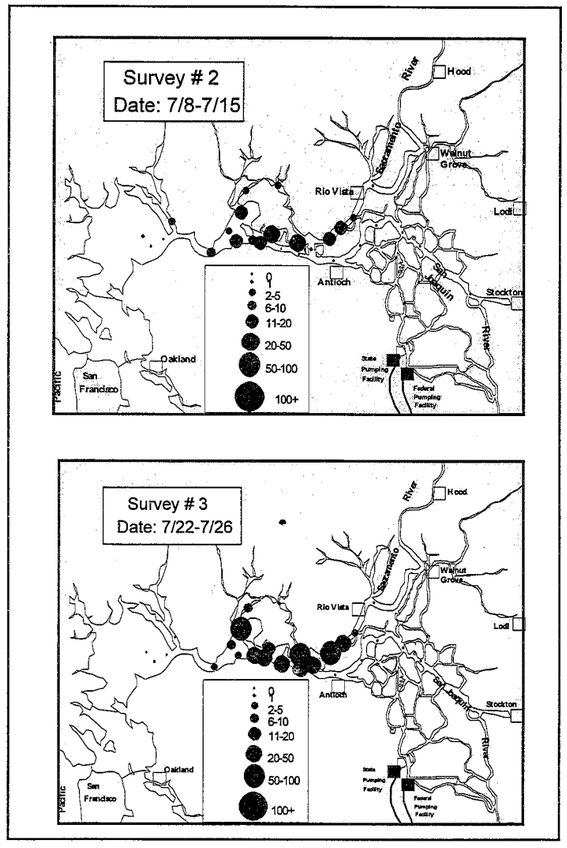

Figure 5
DELTA SMELT CATCH, 1996 SUMMER TOW-NET SURVEY
Circles represent total catch of delta smelt at 38 fixed sampling locations. Survey 1 was canceled due to boat problems.

Preliminary analyses of the possible mechanisms for the decline suggest that:

- Delta smelt average lengths were smaller in the summer of 1996 than in previous years.
- Zooplankton density in 1996 did not appear to be lower than in previous years.
- There was no evidence of direct contaminant effects on delta smelt, but there was evidence of toxic effects on mysids in Grizzly Bay and near the confluence (see Autumn 1996 *Newsletter*).
- There was no evidence that water temperature was different in 1996 than in previous years.

Further research is underway on these mechanisms and others that would explain the apparent delta smelt mortality in 1996.

salvaged in late spring and early summer. Therefore, it appears that delta smelt nursery habitat was completely downstream of the influence of the pumping facilities in 1995.

On May 16, 1996, about 60 researchers and others attended a second delta smelt workshop at Contra Cost Water District headquarters. Topics included current sampling programs, delta smelt diets, reproduction, genetics, environmental tolerances, X_2 relationships, entrainment, culture, and toxicants. Following the talks, a panel discussed the future direction of delta smelt research. Input from this discussion session was used to plan future delta smelt research. One addition to delta smelt research in 1997 that resulted from this discussion is a pilot study to investigate delta smelt use of shallow water habitat in the estuary.

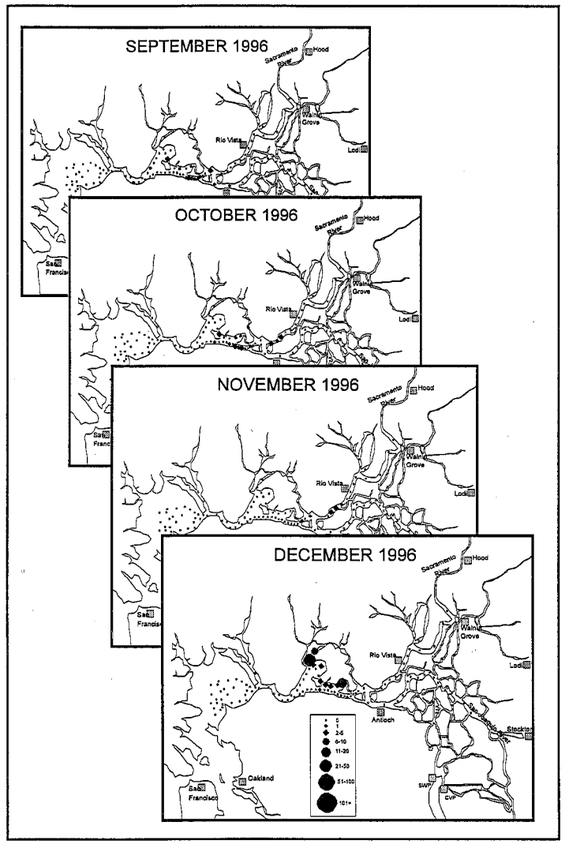

Figure 6
DELTA SMELT CATCH, 1996 FALL MIDWATER TRAWL SURVEY
Circles represent total catch of delta smelt at 112 fixed sampling locations.

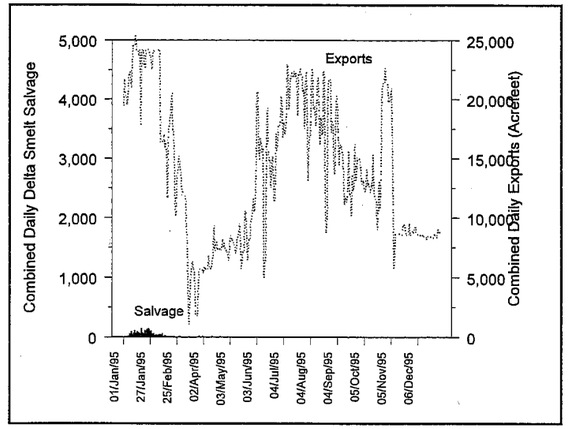

Figure 7
DELTA SMELT SALVAGE AT THE CVP AND SWP IN 1995
Bars represent combined daily salvage of delta smelt.
Line represents combined daily exports in Acrefeet.

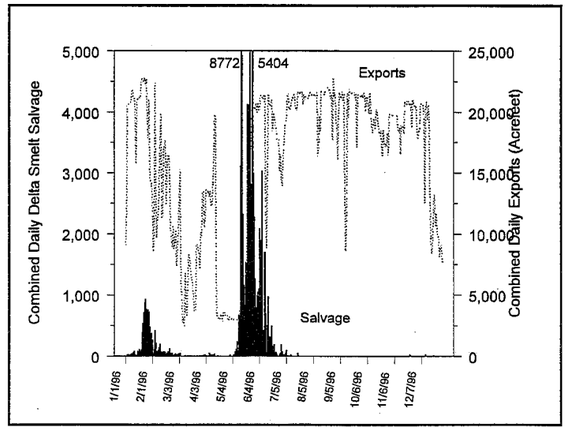

Figure 8
DELTA SMELT SALVAGE AT THE CVP AND SWP IN 1996
Bars represent combined daily salvage of delta smelt.
Line represents combined daily exports in acre-feet.

The Central Valley Chinook Salmon Symposium, originally scheduled for May 13-14 at Bodega Marine Laboratory, has been rescheduled to October 22-23, 1997. It will still be at Bodega Marine Laboratory.

Details will be available in the Summer *Newsletter*.

Splittail and Longfin Smelt Abundance

Randall Baxter

The fall midwater trawl splittail index for 1996 was well below that of 1995, but still the second highest since 1987 (Figure 1). About half of the 1996 index was made up of young-of-the-year. Last year was the first "wet" year in which no young-of-the-year splittail were collected by the otter trawl at Bay Study index stations (Figure 2), but five young-of-the-year splittail were collected at new, non-index delta stations. These surveys indicate some recruitment of young-of-the-year in 1996, but not a lot for a wet year.

Longfin smelt indices for 1996 were low relative to 1995, but represent a substantial increase in abundance for the even-year cohort (Figures 3 and 4). Longfin smelt spawn at about their second birthday, so the 1996 young-of-the-year are progeny of the small 1994 year-class. The fall midwater trawl index, as sometimes happens, was composed almost entirely of a single month's catch (December index 1309; total 1356). This "late" index often results when maturing individuals of a strong year-class initiate their spawning run and younger fish follow them upstream. In December 1996, length-frequency data confirmed that slightly more than half the catch was composed of maturing, 1995 year-class fish (and possibly some 1994 year-class fish); the rest were 1996 young-of-the-year. The 1996 indices are comparable to those in 1993; thus, the even-year cohort is now large enough to produce a reproductive response comparable to that of 1995 if outflow conditions are good in winter 1998.

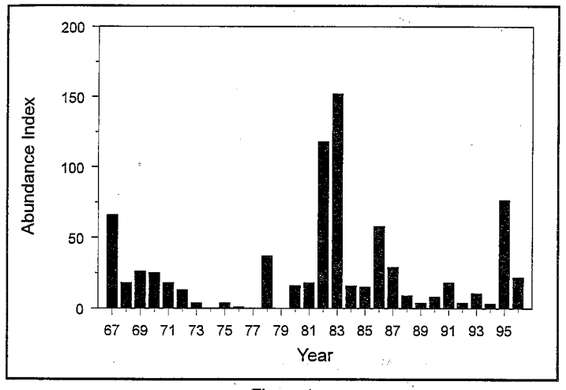

Figure 1
SPLITTAIL ABUNDANCE INDEX
BASED ON THE FALL MIDWATER TRAWL
Index includes all age groups. No sampling in 1974 or 1979.

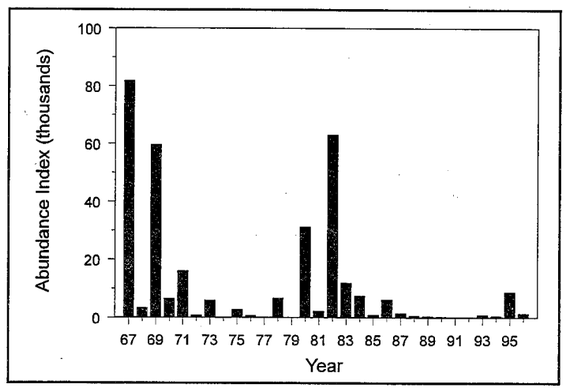

Figure 3
LONGFIN SMELT ABUNDANCE INDEX BASED ON THE FALL MIDWATER TRAWL
Index includes all age groups. No sampling in 1974 or 1979.

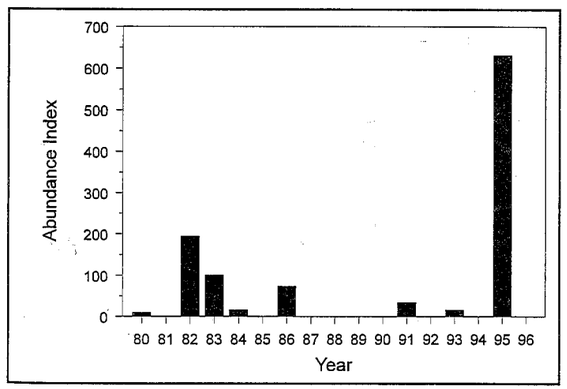

Figure 2
SPLITTAIL YOUNG-OF-THE-YEAR ABUNDANCE INDEX
BASED ON THE BAY STUDY OTTER TRAWL

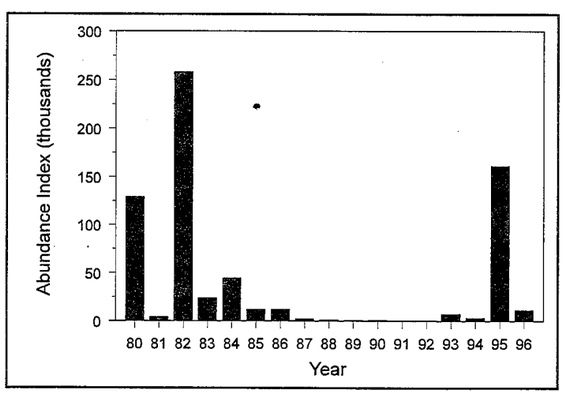

Figure 4
LONGFIN SMELT YOUNG-OF-THE-YEAR INDEX
BASED ON THE BAY STUDY OTTER TRAWL